UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Memorandum

SUBJECT: Benefits Assessment for Disulfoton Use on Potatoes and Radish Seed

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September 26, 2001

Summary of Analysis

This assessment investigates the pest management and economic benefits of the use of liquid disulfoton in potatoes and radishes, in the context of mitigation proposed for risks faced by mixer/loaders and applicators of this insecticide. Disulfoton appears to have very different benefits in the production of each of these crops.

In potatoes, while disulfoton has historically been an important component of the chemical arsenal used against aphid pests, its use in the past two years or so has declined greatly. It is now used on a small proportion of the total US crop, though in some areas, particularly Idaho, it remains an insecticide of some importance. This reduction in use is largely a result of the development of effective alternative insecticides. As long as the currently available insecticide options exist, however, growers should still be able to achieve adequate control of pests, though perhaps less economically, without liquid disulfoton.

In radishes grown for seed, liquid disulfoton use is a much more important pest management tool for those growers operating in Washington state. Producers in this region face aphid pests not seen in other areas, and have

many fewer chemical alternatives available to them, as compared to potato growers. The economics of radish seed production create a small profit margin and this also contributes to the importance of disulfoton, which is both cheap and efficacious in its liquid form. Thus, in this crop, and for this region in particular, liquid disulfoton use has critical benefits and risk mitigation should be carefully considered.

Background

Disulfoton is an organophosphate insecticide used on a wide variety of crops in part because it not only has contact toxicity but is also taken up by plant root systems and remains active against target insects for a relatively long time. It is available for both the crops addressed here in both liquid and granular form. Risk modeling by the Health Effects Division indicates that this chemical may pose the greatest hazards to mixer/loaders and applicators if the liquid form is applied aerially or via chemigation. Furthermore, the liquid form is more hazardous than the granular form (regardless of application method). Therefore, SRRD has asked BEAD to investigate the importance of liquid disulfoton in U.S. production of potatoes and radishes grown for seed, as well as the impacts created by restrictions on these pest control practices.

Role of disulfoton and chemical alternatives available in potato production

Disulfoton has historically been used as one of many insecticides in this crop to control aphid infestations across the U.S. The main targets of this use are the green peach aphid, *Myzus persicae*, and the potato aphid, *Macrosiphum euphorbiae*. During the period from 1987-1998, an average of 4 % of the nation's potato acreage was treated with this chemical, and in 1999, the National Potato Council asserted in a letter to EPA that it was an important component of aphid pest management, in both its granular and liquid forms. In addition to suppression of pest populations, disulfoton is also used to manage resistance to organophosphate insecticides, a phenomenon common in the targeted aphid species. Granular disulfoton is applied at planting to control early season aphid populations. A subsequent application of liquid disulfoton may also be made during the growing season, either aerially, by ground sprayers, or chemigation. However, the latest USDA/NASS statistics available indicate that in 1999, an average of only a single application was used in the states surveyed (including Colorado, all Pacific Northwest growing regions, Indiana, Maine, Minnesota, North Dakota, Pennsylvania, and Wisconsin). Since 1999, the average U.S. acreage treated with disulfoton has declined to 1 % (USDA/NASS statistics, 2000). Indeed, in some states (Delaware, Florida, North Carolina) growers apparently no longer apply this insecticide, and it is not listed as an insecticide option in crop profiles published by extension services in these states, despite current registration (USDA Crop Profiles for Delaware, Florida, Ohio, North Carolina, and Pennsylvania).

In Idaho, however, disulfoton use is higher than the national average. The latest published information indicates that 4 % of the total acres grown were treated with disulfoton (USDA Crop Profile). This use appears to be predominantly of the liquid form. In some areas of Idaho the systemic uptake of disulfoton by plants translates into less harmful effects on beneficial insects such as pollinators, which are important in adjacent crops such as alfalfa (A. Schreiber, R. Stoltz, *pers. comm*.). Some growers in Washington state also use disulfoton, for the same reason (A. Schreiber, *pers. comm*.). Disulfoton is applied aerially in these regions so as not to damage potato vines (as would occur if ground spray equipment were used). In Washington an estimated 90 % of disulfoton applications are of the liquid form, applied aerially (A. Schreiber, *pers. comm*.). No such information has been provided for Idaho.

Reduction in disulfoton use in recent years has apparently occurred largely because of the registration and adoption (by growers) in the past two years, of other insecticides for similar purposes in potato (A. Schreiber, R. Stoltz, M. Aerts, *pers. comm*.). These include imidacloprid, pymetrozine, and thiamethoxam. These chemicals join a set of other insecticides that together provide adequate control of the target pests in most regions of production. Information provided by extension service contacts in Florida suggest that the insecticides that are currently used most commonly against the aphid pests principally targeted by disulfoton are methamidophos, aldicarb, and imidacloprid (M. Aerts, *pers. comm*.). Like disulfoton, both imidacloprid and methamidophos have good systemic activity against aphids (Crop Profiles for Wisconsin, Idaho). Furthermore, imidacloprid, in particular, also controls other pests, such as the Colorado potato beetle and whiteflies, that often occur at the same time as aphids and are not as well managed with disulfoton (Crop Profiles for Florida, Wisconsin). These aspects have probably contributed to the adoption of these insecticides for pest control in potatoes.

Role of disulfoton and chemical alternatives available in the production of radishes grown for seed

In this crop, disulfoton is used only by growers in the Columbia basin area of Washington state, on a "special local needs" (24c) label. Radish seed is a minor, but economically important crop for producers in the Columbia Basin of Washington. Production from here is utilized domestically and internationally for growing fresh radishes for consumers. Radish seed is grown in regions where cool, wet seasons consistently predominate, and in the U.S. the crop has historically been grown in the Pacific northwest and California (McGregor, 1976). Further information on the current extent of the total U.S. crop are not available, however, as it does not appear to be tracked by USDA's agricultural surveys. The crop is an annual one, and, in Washington, it is planted in March and harvested in August (G. Pelter, *pers. comm*). Disulfoton use is targeted toward two aphid species, the cabbage aphid (*Brevicoryne brassicae*) and the turnip aphid (*Rhopalosiphum pseudobrassicae*). They cause premature crop senescence, which results in yield loss and/or loss of seed quality. They also make harvesting very difficult when their sticky "honeydew" (excreta) coats machines.

Growers operate with a slim profit margin and produce a relatively small acreage of this crop - 635 acres total in this area in 2000 (G. Pelter, *pers. comm*.). As a result, aphid damage, if not rigorously controlled, could easily be catastrophic for individual farmers. Disulfoton is applied in both granular and liquid form on radishes in this region, and virtually all acreage receives one application, early in the growing season after seed stalks form on plants. Growers usually apply the insecticide themselves (G. Pelter, *pers. comm*). Liquid disulfoton is applied as a soil injection in combination with a fertilizer. The application to an average field (typically 20 to 25 acres in size) takes an estimated four hours at most. Thus, a grower would be typically exposed to disulfoton only once annually, and only during mixing-loading operations (G. Pelter, *pers. comm*.).

Pirimicarb, chlorpyrifos, pymetrozine are the only registered chemical control alternatives available to growers for these insect pests. Pirimicarb is already used once to control late-season infestations of these aphids, if at all. Chlorpyrifos cannot be used during bloom, when aphids can occur, due to toxicity to honey bees that pollinate this and other nearby crops. Pymetrozine is relatively expensive and does not provide good lower canopy control. Disulfoton is also advantageous in that it allows predatory and parasitic insects to develop in seed radish fields, since other insecticides are not utilized until later in the growing season (if at all). As a result disulfoton is considered an important part of the industry's IPM program (G. Pelter, *pers. comm*.).

Economic impact of mitigation of disulfoton risks in potato

Curtailing liquid application of disulfoton could motivate growers to switch to other registered alternatives, such as imidacloprid, or increase the applications of methamidophos in addition to the current pesticide control regime. In order to estimate the economic impact to the potato industry, disulfoton was compared with methamidophos and imidacloprid using a five year historical range of production costs and grower revenues. Washington State, Idaho and Wisconsin were selected for this analysis. In 2000, these three states together harvested over 60 % of the total US market supply of potatoes and generated a combined total of $ 1.3 billion of revenue. Washington State and Idaho applied an average of 11,000 lbs of disulfoton in 2000. Using the worst case scenario for this analysis, an additional application of methamidophos could result in an $11 increase in the cost of chemical inputs per season. Applying the maximum label rate for imidacloprid could increase grower costs approximately $ 45 per season. Replacing disulfoton with methamidophos or imidacloprid in Washington State could result in economic losses for the local potato industry of approximately 0.3-1.6% per year. The Wisconsin potato industry could potentially lose 0.5-2.3 % as a result of mitigation. The most severe impact of mitigation could occur in Idaho, where economic losses to the potato industry are 0.7-2.9 % per year, at most. Thus, the potential economic loss resulting from substituting either methamidophos or imidacloprid for disulfoton would appear to cause a negligible economic impact given the potato industry's overall gross earnings.

Economic impact of mitigation of disulfoton risks in radishes grown for seed

Economic data for radish seed are scarce and information could be found for only 635 acres in Washington State. Based on information from Washington state, break-even analysis shows that growers are currently operating under very narrow profit margins. Given a $ 0.93 break-even price per pound of radish seed and average prices for radish seed at $ 0.93 per lb, an increase in production costs could negatively impact grower operations significantly. Washington State University agricultural extension agent Gary Pelter claims that without liquid disulfoton, growers would have to purchase new equipment in order to apply a granular form of the chemical. The cost to purchase this equipment and switch to a new formulation, Mr. Pelter states, would be in excess of $ 9,000 per grower. He also estimates that the cost of applying liquid fertilizer separately would add about $ 40 per acre to a grower's production costs. Therefore, impact of mitigation could create a severe economic burden to an apparently fragile radish seed industry.

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